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ABSTRACT

The present study used a set of bimodal (auditory-visual) conflict designed specifically for the preschool child. The basic component was a match-to-sample sequence designed to reduce the often-found contaminating factors in studies with young children: failure to understand or remember instructions, inability to perform the indicator response, or disinterest or avoidance. The Ss were 99 children, mostly from low-income neighborhoods. All major ethnic groups were represented. Two age groups separated by a 4-mo. interval were selected to facilitate identification of developmental changes. The visual stimuli were photographs of people, animals, and common objects. The task, in all series, was to match basic categories such as "trucks" or "horses". For the Auditory (A) series (and Bimodal Conflict, BC), the sample was a tape-recorded sound (cat meowing) or a label ("dog"). Procedures were designed to give the advantage of both primacy and recency to visual matches. First, a shaping procedure was used to teach the match-to-sample set in the visual mode. After five training items, the practice series was presented: four V items, eight A items and then four V trials. Results of the initial BC test showed a marked age difference in modality choice. The majority of the older children (59%) selected V matches, while very few of the younger children (13%) chose to match the V stimuli. It is clear that the primacy and recency of the V trials in the training-practice series did not discourage A responding in younger Ss. It is further suggested that the developmental difference was a function of the 5-year-old's more malleable task set. Implications are given. (CK)

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INFORMATION PROCESSING IN AUDITORY - VISUAL CONFLICT

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Today we witness a resurgence of interest in the role of stimulus modality in information processing. Modality-oriented approaches to specific cognitive and academic deficits are yielding provocative hypotheses about bisensory integration, dominance patterns, and competence in modality shifting (e.g., Birch & Belmont, 1965; Deutsch & Schumer, 1970). Little is known, however, about early developmental changes in the complex interplay between vision and audition, the two modalities most relevant for academic tasks.

The present study used a test of bimodal (auditory - visual) conflict designed specifically for the preschool child. Stimuli were analogous to those encountered in daily learning situations. The basic component was a match-to-sample sequence designed to reduce the often-found contaminating factors in studies with young children: failure to understand or remember instructions, inability to perform the indicator response, or disinterest or avoidance.

Each child was given a brief training series on a visual match-to-sample task, a practice series containing both visual and auditory problems presented separately, and then three bimodal conflict tests in which discrepant auditory and visual samples were presented simultaneously. The three tests of auditory and visual choices were conducted after unimodal practice, after a priming sequence designed to channel choices toward one modality, and during a series on which the child received direct instruction on each trial. Tests were arranged in order of increasing specificity of instructions (encouraging the child to choose the modality nonpreferred on the previous test) so that the effects of modality preference could be separated from, and related to, the effects of task-specific sets. The main question asked was, Which stimulus modality exerts the greater influence on the child's choices? In more subjective terms, are children more likely to choose what they see or what they hear, and is modality choice related to developmental level?

METHOD

Subjects. The *S*s were 99 children, mostly from low-income neighborhoods. All major ethnic groups were represented. Two age groups separated by a 4-mo. interval were selected to facilitate identification of developmental changes. The 15 boys and 15 girls in the younger group ranged in age from 50 to 59 mo. ($\bar{X}$ = 55.1). The older 34 boys and 35 girls were between 64 and 73 mo. ($\bar{X}$ = 68.0).

Stimuli. The visual stimuli were photographs of people, animals, and common objects. Each 14 × 22 in. display board contained three comparison pictures in a row across the bottom, and those used in the Visual (V) and Bimodal Conflict (BC) series contained a fourth picture, the sample, centered at the top. For the Auditory (A) series (and BC) the sample was a tape-recorded sound (cat meowing) or a label ("dog").

Procedure. The task, in all series, was to match basic categories such as "trucks" or "horses." The child indicated his selection by touching one of the three lower cards. Except for the training series, a noncorrection procedure was used, and each choice was praised.

Training and practice. Since pretesting with an independent sample indicated that auditory matches were highly probable at these ages, procedures were designed to give the advantage of both primacy and recency to visual matches. First, a shaping procedure was used to teach the match-to-sample set in the visual mode. After five training items, the practice series was presented: four V items, eight A items, and then four V trials.

Bimodal conflict series. The child received no new instructions and no warning of a change in procedure. Modality preference was determined by a child's responses on four trials (the initial BC test). Discrepant A and V sample stimuli were presented simultaneously. One of the response alternatives matched the V sample, one matched the A sample, and the other matched neither. For example, as the child heard "dress," he saw a display containing a picture of a lamp in the position of the sample. His three comparison stimuli were a different lamp, a goose, and a dress.

The next four trials comprised the unimodal Prime sequence, intended as a subtle attempt to shift the child's response set away from that shown on the initial BC test. If a child made more V than A responses on this first test, he was assigned to Prime-A, consisting of four trials on which the samples were labels only; no V samples were given. If a child showed an auditory preference or an equal split, he was assigned to Prime-V and received four V items for which no A match was possible. Additional BC items (the Primed Shift test) were then given to assess whether or not the priming had shifted the child's response modality.

In the final or Directed Shift phase, an intensive effort was made to shift the child from one modality to the other. Children who had given A responses on the Primed Shift test were told before each trial, "This time, *look*, don't listen. Look at the one at the top and pick the one that goes with it. Remember now, just *look*." Parallel instructions, emphasizing the auditory mode, were given to children who had given V responses.

RESULTS

Results of the initial BC test showed a marked age difference in modality choice. The majority of the older children (59%) selected V matches, while very few of the younger children (13%) chose to match the V stimuli (χ^2 = 16.10, $p < .001$). It is clear that the primacy and recency of the V trials in the training-practice series did not discourage A responding in younger *S*s.

On the Primed Shift test, most children exposed to Prime-A (78%) shifted to the auditory mode, while only 2 of the 54 children given Prime-V shifted to the visual mode

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($\chi^2 = 54.42, p < .001$). This modality effect was significant within both the younger and older groups ($p_e = .001$ and $\chi^2 = 30.69, p < .001$, respectively) and shows the greater probability of shifting into the A mode.

Most of the children (88%) were given V instructions during the Directed Shift trials. Sixty-two percent of these *Ss* were those who were in the Prime-V condition and did not shift on the Primed Shift test. For these "second try" children, the explicit instructions represented an additional attempt to effect a shift to the visual modality. The remaining 38% showed V choices initially and shifted successfully to the A mode after Prime-A. In other words, this group had already demonstrated one successful shift and the function of the explicit instructions was to encourage a second shift, this time back to the originally preferred modality.

The results showed that children who shifted to the A mode after priming were also more likely to show V responses here, while those who did not shift after priming were unlikely to do so under explicit instructions (Kolmolgorov-Smirnov Test: $D = .531, p < .001$). The same analysis was done within the older group and the results were identical to those of the total sample. Since only 12 children reached the criterion for auditory instructions, no analyses of subgroup patterns were conducted for this group.

It should be noted that some children did not show an unambiguous modality preference on the initial BC test; 16% of the *Ss* made fewer than three out of four choices in a single modality. Examination of individual records showed that most of these *Ss*, 11 of whom were in the younger group, seemed to be making position-guided rather than modality-guided responses. As a cautionary measure, all data analyses reported above were repeated without these *Ss*, even though position habits were almost always broken by the Prime condition. The pattern of findings was identical to that of the total sample.

DISCUSSION

A major finding was the consistent dominance of the auditory stimuli; there were more A than V responses under all experimental conditions. To summarize the specific results: more older than younger children matched to the visual standard initially; unimodal priming was more effective in increasing shifts to the auditory mode than to the visual mode; and children who had already shifted modalities once were more likely to succeed in ignoring a competing stimulus and shifting to the visual mode than were children who made no prior shift.

The most plausible interpretation of these data combines the notions of "auditory capture" and malleability of "task set." It is suggested that 4-yr.-olds make few visual choices because at this age level auditory stimuli have an apparently obligatory quality that cannot be ignored. Older children, in contrast, are more competent at resisting the intrusive (auditory) stimuli.

It is further suggested that the developmental difference was a function at least in part of the 5-yr.-old's more malleable task set or his greater ability to modulate his performance in accord with social cues and, in particular, verbal instruction. It seems reasonable to hypothesize that the fifth year is a transitional stage between reacting in an obligatory manner to competing auditory stimuli and inhibiting this reactivity in response to the demands of the experimental or academic task.

Implications. In addition to generating information applicable to theories of perceptual-cognitive development, studies using the present paradigm may contribute toward our understanding of specific learning disabilities. Recent investigations indicate that poor readers have difficulty when intermodal, particularly audiovisual, information processing is required (Beery, 1967; Birch & Belmont, 1965). In tasks involving recall of bimodal stimuli (Senf, 1969; Senf & Freundl, 1971), auditory preferences were noted in learning disability *Ss* but not in normals and suggested the possible role of auditory distraction, auditory dominance, and avoidance responses in relation to visual stimuli. Further study of modality processes, using a task such as the present one which carries a very light memory load, would help localize areas of competence as well as deficit in children experiencing academic difficulties. A child's consistent preference for auditory tasks (and his delight in recorded stimuli) could be harnessed in the development of fruitful curricular programs.

This study also has implications for the hypothesis that low-income or minority group children experience academic difficulties because they are visual rather than auditory learners (Riessman, 1967). Studies using the bimodal conflict paradigm to test such hypotheses regarding learning disabilities and cultural differences are in progress.

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